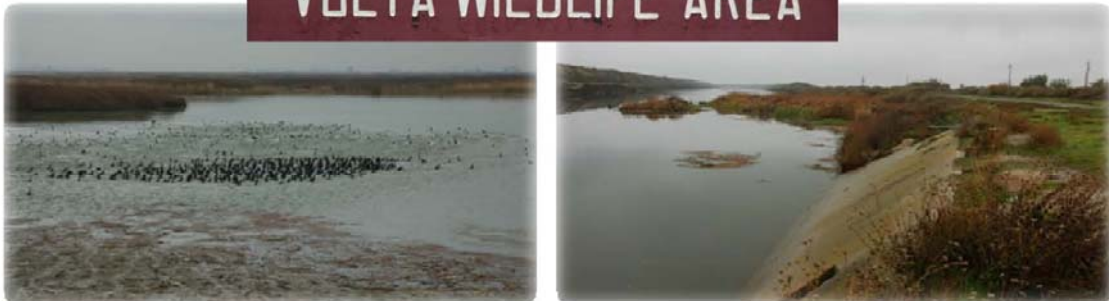


## **Appendix B – Project Monitoring Plan**



# FINAL PROJECT MONITORING PLAN

DEPARTMENT OF FISH AND GAME  
VOLTA WILDLIFE AREA



MAY 2010

VOLTA WILDLIFE AREA  
LEVEL 2 DIVERSIFICATION /  
INCREMENTAL LEVEL 4  
DEVELOPMENT  
PILOT PROJECT

## 1. Introduction

The Central Valley Project Improvement Act (CVPIA) of 1992 requires that the Department of the Interior acquire additional water supplies to meet optimal waterfowl and wildlife habitat management needs on refuges within California's Central Valley. These refuges collectively encompass National Wildlife Refuges, State Wildlife Management Areas and the Grassland Resource Conservation District (GRCD). The Bureau of Reclamation (Reclamation) is acting on behalf of the Department of Interior to fulfill these requirements.

Specific water management goals have been determined for two independent water supply levels termed Level 2 and Level 4. Level 2 refuge water refers to the average amount of water the refuges received between 1977 and 1984. Level 4 water is the amount of water required for full development of the refuges based upon the management goals of individual refuges and wildlife areas, consistent with CVPIA 3406(d)1 and (d)2. Incremental Level 4 water is the difference between full Level 4 and Level 2 water supply. Level 2 refuge water is normally utilized between September 1<sup>st</sup> and March 15<sup>th</sup> where as the Level 4 supply is used for summer brood habitat maintenance and spring/summer irrigations. In order to meet goals associated the CVPIA, Reclamation desires to increase the use of alternative refuge water supply sources by diversifying Level 2 refuge water supplies while increasing local sources of Incremental Level 4 refuge water supply. The Volta Wasteway Level 2 Diversification/Incremental Level 4 Development Pilot Project (Pilot Project) is a three-year demonstration project to evaluate the feasibility of groundwater utilization to diversify a portion of Level 2 supply and to supplement Incremental Level 4 supplies to wildlife refuges within California's San Joaquin (SJ) Valley.

Wetlands in the Central Valley are intensively managed to produce standing crops of plants and invertebrates with high value to wildlife. An effective method of wildlife food production is moist soil management. Moist soil management includes the timing of hydro-periods to optimize germination and plant growth. Grassland Water District (GWD) is responsible for the annual delivery of over 180,000 acre feet (AF) of water to seasonal and semi-permanent federal, state and private wetlands within the GRCD. The 180,000 AF of water that the GWD is responsible for delivering is composed of 125,000 AF of Level 2 supply, and 55,000 AF of Level 4 supply. In 13 of 14 years, Reclamation has been unable to provide the 55,000 AF of Incremental Level 4 water deliveries annually, as required by the CVPIA of 1992. In 2008 and 2009 the GWD received less than 24% of its obligated Level 4 surface water supply. Level 4 water supplies are critical for the optimization of seed and biomass production, the health and survival of locally breeding shorebirds and waterfowl, the state and federally threatened Giant Garter Snake (GGS) and the productivity of the largest of California's remaining wetlands.

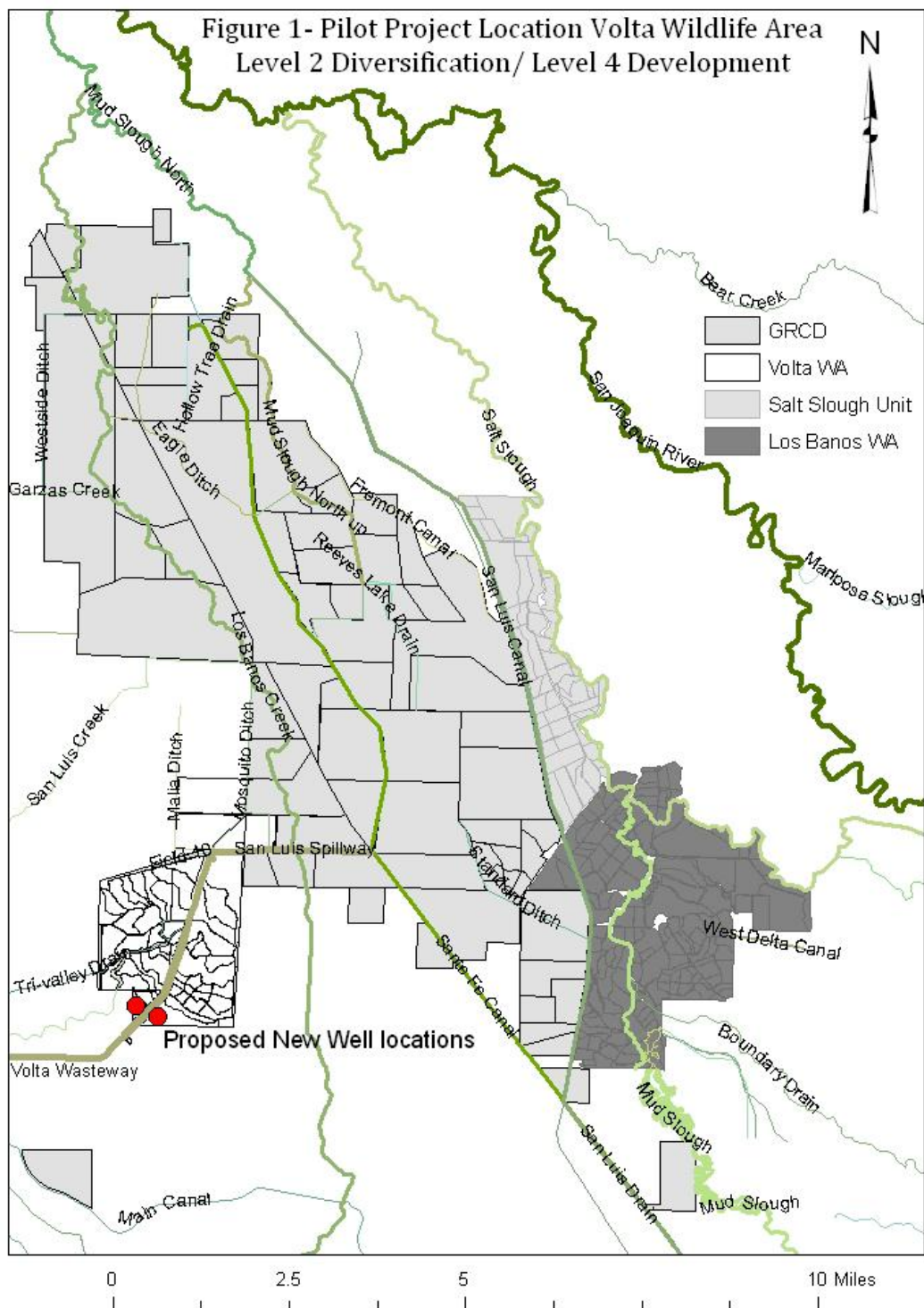
The Pilot Project proposes the installation of two deep groundwater wells to develop up to 2,000 AF between September 1, 2010 and February 28, 2011 in year 1 and potentially up to 5,000 AF/year in years 2 and 3 of new CVPIA Level 2 and Incremental Level 4 water supplies. The additional water developed through this Pilot Project would augment south of Delta shortages to the wetlands by annually supplying up to 2,500 AF of Level 2 and up to 2,500 AF of Incremental Level 4 supplies (years 2 and 3). Agricultural contractors would benefit by receiving up to 2,500 AF of Central Valley Project surface water annually made available by the groundwater pumping at Volta Wildlife Management Area (WMA).

## **Project Setting**

The Volta Wasteway is located approximately six miles northwest of Los Banos in western Merced County (Figure 1). The Volta WMA is owned by Reclamation and has been operated by the California Department of Fish and Game (CDFG) since 1952 under a lease agreement. The Volta Wasteway is the primary supply canal for the Northern Division of the GRCD. Water is released from the Delta Mendota Canal (DMC) to the Wasteway through a variety of control structures for distribution throughout the Northern GRCD. The Wasteway conveys flows directly to the Volta WMA through lift pumps, and to the GRCD through releases out of control structures located in Pond 10<sup>1</sup>. Pond 10 structures are located at the terminus of the Wasteway and directly feed into the Santa Fe Canal Cross Channel, Mosquito Ditch and Malia Ditch. Wetlands in this region are typically flooded in late August to early September with flows in the Wasteway reaching 450 cubic feet per second (cfs). Wetland water elevations are maintained throughout the GRCD with maintenance flows from late October through the winter months to provide foraging and loafing habitat for waterfowl, shorebirds and other species. During the fall and winter maintenance flow periods, the Wasteway experiences flows up to 100 cfs. In the spring when soil temperatures are optimal for seed germination and successive plant growth, the wetlands are drained. Waters drained from these wetlands are conveyed to Mud Slough and Los Banos Creek which ultimately discharge to the San Joaquin River. Beginning in late April and continuing through the summer months, irrigation flows are delivered to the wetlands, filled and subsequently drained. During these periods the Wasteway can experience flows up to 150 cfs.

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<sup>1</sup> Pond 10 and Field 10 are used interchangeably throughout this document.



## **Project Objectives**

The objectives of this Pilot Project are to: (1) develop a long-term groundwater supply that can be used to diversify CVP water supply sources and improve water supply reliability for CVP contractors, as well as supplementing Incremental Level 4 supplies for the SJ Valley Refuges, and (2) to confirm that the groundwater quality is acceptable for refuge use. Reclamation's goal is to pump up to 2,000 AF between September 1, 2010 and February 28, 2011 in year one, potentially producing up to 5,000 AF of groundwater per year (2011-2013) from this Pilot Project. Two production wells are to be installed and operated at maximum capacity (target of approximately 1,500 gpm per well) for three years. If target maximum capacity of 1,500 gpm per well is achieved, the two wells will produce 2,000 AF in 151 days of operation. Production well operation, timing and duration will be determined by Reclamation in coordination with GWD and CDFG based on water demand and both well and surface water quality. If the well operational goal of September 1, 2010 is achieved, as well as the target maximum capacity of 1,500 gpm, pumping could occur through January 29, 2011 but no later than February 28, 2011 in year one. In years two and three, Reclamation's goal is to pump up to 5,000 AF. The project water will be supplied to south of Delta refuges that are entitled to receive CVP water pursuant to Section 3406(d) of the CVPIA, show a demonstrated need or shortfall, and can receive the water by direct delivery from the Volta Wasteway.

## **Project Viability**

The key elements of project viability are the sustainable yield of the two new production wells to be screened below the Corcoran Clay and the quality of the water ascertained. Surface water and production well water quality monitoring will determine if and when adequate surface water dilution is available to meet State Water Resource Control Board's (SWRCB) water quality objectives outlined in the Central Valley Basin Plan and determine timing of well usage. This Project Monitoring Plan describes the data to be collected during the three-year demonstration period to address the project objectives and assess the long-term viability of the project.

## **2. Hydrogeologic Setting**

The Volta WMA is located in the Merced sub-basin of the San Joaquin Valley basin. Groundwater supplies are present in unconsolidated deposits extending to 900 feet or more below grade. An upper, semi-confined aquifer extends from approximately 50 feet to 250 feet below grade. The Corcoran Clay, a regional aquitard that acts as a semi-confining unit, separates the upper semi-confined aquifer from deeper alluvial deposits, which form the lower confined aquifer. In the project area, the Corcoran Clay is found at approximately 250 feet to 450 feet below ground surface (bgs).

Wells screened in the semi-confined aquifer above the Corcoran Clay are likely to be in hydraulic communication with overlying surface water features, such as the Volta Wasteway and wetlands areas in the Volta WMA. Wells screened in the lower confined aquifer are not as likely to be in communication with surface water resources. Due to the potential mixing of waters between the two aquifer units, the Merced County Environmental Health Department (MCEHD) prohibits the construction of wells that are open to both aquifers within the same borehole.

## **Aquifer Yields**

High-capacity wells screened in the lower confined aquifer in the vicinity of the Volta WMA reportedly yield from 1,000 to 1,500 gpm and as high as 2,000 gpm. Well yields are known to vary considerably in this area.

## **Groundwater Quality**

The groundwater quality within the Merced sub-basin varies with location and depth both within the upper semi-confined and lower confined aquifers. In the lower confined aquifer, total dissolved solids (TDS) concentrations generally range from 100 to 3,600 milligrams per liter (mg/L). In two test holes drilled in the Volta WMA, TDS ranged from 300 mg/L (near the southern property boundary in close proximity to the proposed well locations) to over 1,500 mg/L (near the northern property boundary approximately 3 miles from proposed well locations). Wells operated by a local food processing plant yield groundwater from the lower confined aquifer with TDS concentrations ranging from 570 mg/L to 2,000 mg/L and electrical conductivity measurements ranging from 1,000 to 3,400 micro-Siemens ( $\mu\text{S}$ ). Based on this limited data, and discussions with local drillers familiar with the area, it is evident that the water quality of the lower confined aquifer is variable throughout the Merced sub-basin.

According to MCEHD and the California Regional Water Quality Control Board, Central Valley Region (CRWQCB-SJR), constituents other than TDS that can affect water quality in the area include dissolved metals and nutrients.

## **3. Project Monitoring Plan Objectives**

To meet the overall project objectives, this Project Monitoring Plan has the following objectives: (1) identify the data to be collected during the three-year Pilot Project to evaluate the overall project objectives; (2) specify the data collection procedures; and (3) clarify the responsibilities for data collection and interpretation for implementation of the Project Monitoring Plan. The information collected, interpreted, and reported in this monitoring program will address the project objectives for this Pilot Project.

There are four primary components that will be monitored as part of this program. These components are as follows:

- Hydrogeology – groundwater supply issues associated with the extraction and discharge of groundwater to the Volta Wasteway. This Project Monitoring Plan specifies the data to be collected to evaluate (1) the performance of the two new wells (i.e., well efficiency and long-term yield), (2) the affect the wells have on the surrounding area (i.e., radius of influence and potential interference between the two wells), and (3) whether there is any potential interconnection across the Corcoran Clay between the upper semi-confined and lower confined aquifers as well as within vertically separated water-bearing zones within the upper semi-confined aquifer.
- Water Quality – both ambient groundwater quality in the upper semi-confined and lower confined aquifers and potential changes to surface water quality in the Volta Wasteway due to the discharge of groundwater. This Project Monitoring Plan provides procedures for collecting and analyzing groundwater samples for a range of constituents to initially characterize and then monitor water quality during the three-year demonstration period.
- Biological – monitoring and evaluation of GGS is necessary to determine what effect, if any, the Pilot Project will have on existing GGS populations. This Project Monitoring Plan provides parameters to explore mechanisms leading to population or habitat change, if any, to GGS at the Volta WMA.
- Ground Subsidence – the potential lowering of the ground surface elevation due to the removal of groundwater from beneath the Corcoran Clay. Subsidence monitoring procedures will be developed by Reclamation in consultation with the U.S. Geological Survey (USGS).

#### **4. Implementation Responsibilities**

The overall implementation of this Project Monitoring Plan is the responsibility of Reclamation. The specific responsibilities for implementation of the four main components noted previously are as follows:

- Hydrogeology – Each Volta well will have a cluster of monitoring wells that will be outfitted with vented pressure transducers permanently connected to a data logger and tethered EC probes with on board logging. The GWD Water Quality Monitoring Plan (WQMP) will be responsible for the collection and transmission of data to Reclamation (specifically a technical consultant from Lawrence Berkeley National Laboratory under contract to Reclamation; Reclamation contractor). The Reclamation contractor will be responsible for the interpretation, and reporting of the hydrogeologic data. The GWD



WQMP will be supported by Reclamation for the collection of water level, groundwater pumping (i.e., pumping rate and total volume), and electricity use data.

- Water Quality – the GWD WQMP and Reclamation (specifically the Reclamation contractor) will share the responsibility for implementation of this component. The GWD WQMP will be responsible for the collection, storage and transmission of EC, Flow, and grab sample water quality data to the Reclamation contractor. The Reclamation contractor will be responsible for the interpretation and reporting of discrete groundwater and surface water quality data. The Reclamation contractor will be responsible for the selection of monitoring equipment to measure and log groundwater extraction rates of the water at the production wells. Each well will be outfitted with a digital output totalizing flow meter and a data logger to insure the preservation of data. The GWD WQMP will continue to be responsible for the collection, storage and transmission of data from the existing real time surface water monitoring station located downstream of Field 26. Reclamation will be responsible for the purchase of equipment at each production well. The GWD (with assistance of the Reclamation contractor for troubleshooting) will be responsible the installation and maintenance of the instrumentation for the monitoring stations at each production well.
- Biological - Reclamation proposes that a USFWS-approved giant garter snake (GGS) research scientist (with required USFWS Section 10(a)(1)(A) and CDFG scientific collecting permit(s) conduct biological monitoring at the Volta WMA in conjunction with Pilot Project. The monitoring and evaluation is necessary to determine what effect, if any, the Pilot Project will have on existing GGS populations. The current GGS population at Volta is one of the few extant populations in the San Joaquin Valley and therefore conservation of this population is paramount to the range-wide recovery of this species.
- Ground Subsidence – Reclamation (specifically the Reclamation contractor) will be responsible for coordinating with the USGS for the collection, interpretation, and reporting of ground subsidence data in the Volta WMA.

GWD will be responsible for maintaining the project water quality database, conducting initial quality assurance and quality control reviews of the data, and producing data transmittal reports to the Reclamation contractor and Reclamation. The Reclamation contractor will assist GWD with improvements to data management procedures over the project term. The GWD WQMP, with the assistance of the Reclamation contractor, will produce a final evaluation report, which will be delivered to Reclamation following completion of the demonstration project.

## **5. Scope of Work**

The Pilot Project will be assessed by collecting hydrogeologic, water quality, biological, and subsidence data within the Volta Wasteway and at the Volta WMA, as described below.

### **Hydrogeology**

Two water production wells are to be installed and operated at maximum capacity (target of approximately 1,500 gpm per well) for three years. If target maximum capacity of 1,500 gpm per well is achieved, the two wells will produce 2,000 AF in 151 days of operation. Production well operation, timing and duration will be determined by Reclamation in coordination with GWD and CDFG based on water demand, well and surface water quality, and habitat quality. Prior to the initiation of pumping in year one, baseline depth to water measurements will be taken manually using an electronic water level indicator in the two production wells. During the first month of operation, continuous hourly depth to water measurements will be taken in the two production wells. The GWD WQMP will also collect manual Quality Assurance (QA) depth to water measurements using an electronic water level indicator on a daily basis within the first week of operation, weekly within the first month of operation, and monthly during the operation period. Each well will have a cluster of monitoring wells that will be outfitted with vented pressure transducers permanently connected to a data logger and a tethered EC probe with on board logging. Continuous (hourly) data will be collected at the five Volta monitoring wells (2 clusters of wells; shallow semi-confined, deep semi-confined and sub-Corcoran). Monitoring well EC data will be downloaded on a monthly basis from the tethered probes. During the year one operation period (September 1, 2010-February 28, 2011), the GWD WQMP will collect continuous flow measurements (flow rates and totalizer digital output to data logger) from the two production wells. Hourly rainfall and evaporation pan data will be collected at a site closest to the production wells. Reclamation will obtain electricity use information throughout the operation period in bills received directly.

### **Water Quality**

#### **SALINITY THRESHOLD & POINTS OF COMPLIANCE**

The Volta Wells EC pumping threshold will be the California Department of Fish and Game 5-year Observed Monthly Mean EC + Mean Standard Error (EC Threshold) derived from weekly grab samples from 2005-2009 at the Volta Wasteway Bridge (Table 1.0). The 30 day running average, as measured at the downstream compliance point located at the Volta Wasteway Bridge Real Time Monitoring Station, will be used to determine if the Wasteway EC concentration has exceeded the EC Threshold and will determine well operation for the week(s) to come. A Salinity Threshold Exceedance Provision (STEP Threshold) allows pumping to occur when well water provides salinity dilution to Wasteway surface water, as measured at the newly proposed upstream Real Time Monitoring Station/ Grab Sample Location (Figure 2.0). Thus, if the EC at the Volta Bridge is below

the EC Threshold well pumping is allowed; if the EC at the Volta Bridge is above the EC Threshold but the well water EC is equal to or below the STEP Threshold (EC in the Wasteway upstream of the wells) pumping is allowed; if the EC at the Volta Bridge is above the EC Threshold and the well water is above the STEP Threshold no pumping is allowed the coming week(s).

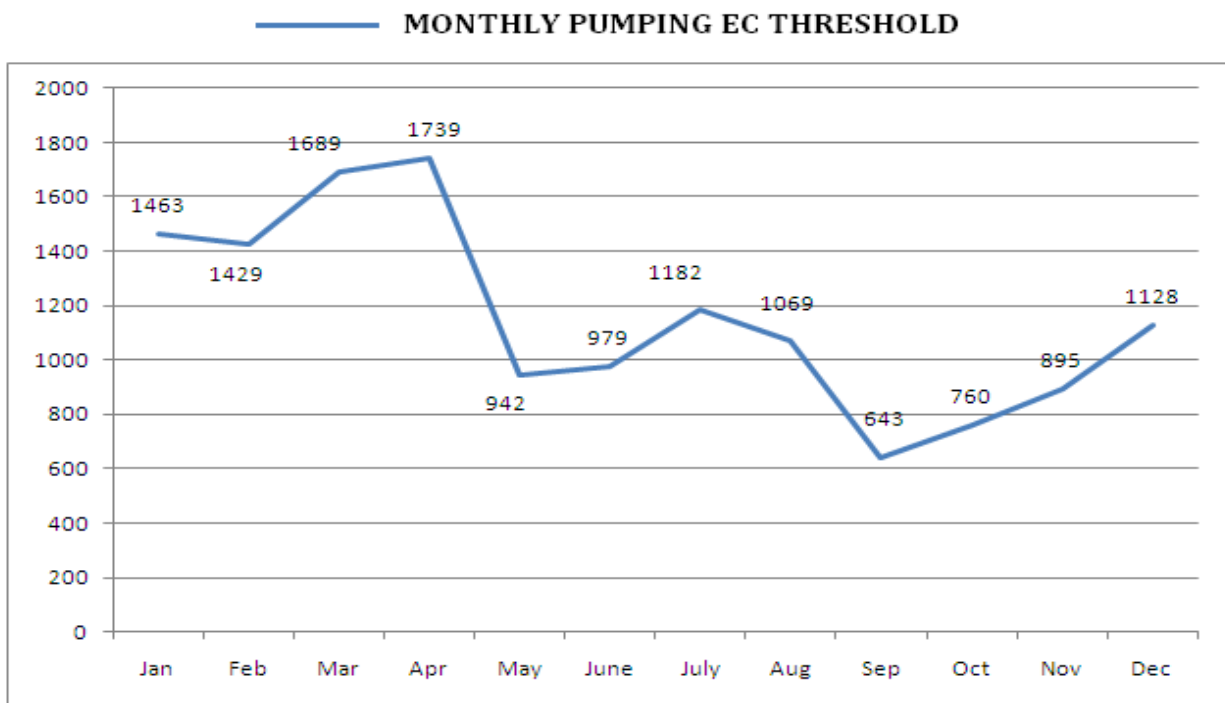
**Table 1.0- Volta Wells EC Pumping Threshold – 5 Yr MONTHLY MEAN EC + 5 Yr MEAN SE (108)**

SE(Standard Error) = 5 Year Mean of observed variance of weekly grab sample EC data applied to 5 Year Monthly Mean EC to establish EC Threshold. 30 Day Running Average Compliance Monitored Weekly.

VOLTA WASTEWAY SURFACE WATER QUALITY DEGRADATION AVOIDANCE PROTOCOL								
MONTHLY MEAN EC DATA FROM WEEKLY CDFG GRAB SAMPLES WASTEWAY BRIDGE, VOLTA WMA 2005-2009								
Month	2005	2006	2007	2008	2009	MONTHLY MEAN EC 2005-2009	MEAN SE 2005-2009	MONTHLY MEAN EC+ MEAN SE 2005-2009
Jan	n/d	1607	942	1550	1321	1355	108	1463
Feb	n/d	966	1664	1207	1446	1321	108	1429
Mar	n/d	1510	1465	1721	1627	1581	108	1689
Apr	1690	1836	1387	1625	1620	1631	108	1739
May	897	824	597	897	956	834	108	942
June	543	712	762	1038	1299	871	108	979
July	718	1059	1246	1161	1187	1074	108	1182
Aug	713	598	1492	912	1089	961	108	1069
Sep	489	389	610	606	583	535	108	643
Oct	487	418	594	725	1038	652	108	760
Nov	760	658	629	1100	n/d	787	108	895
Dec	875	728	1126	1350	n/d	1020	108	1128
Pilot Project Year 1 pumping duration (September 1 - Feb 28) - Giant Garter Snake Prey Avoidance Precaution								
EC Threshold = 5 yr Monthly Mean EC + 5 yr Mean Standard Error observed from 2005-2009 > Pumping Ceases								
Pumping will CEASE at Production Wells if 5 yr Monthly Mean EC + 5 yr Mean SE Threshold is exceeded								
< 5 yr Monthly Mean EC + 5 yr Mean SE Observed from 2005-2009 - Pumping OK								
Threshold Exceedance Provision = Pumping when well WQ < Wasteway WQ (upstream monitoring station)								
EC Compliance Point @ Wasteway Bridge Downstream of Production Wells								
SE= STANDARD ERROR			EC= Electrical Conductivity			n/d= NO DATA		
WQ= Water Quality (EC & Constituent Concentrations)						Constituent= Se, B, Hg		

## **SALINITY MONITORING & THRESHOLD COMPLIANCE**

- 1) The Downstream EC Threshold Compliance Point will be located at the Wasteway Bridge Real Time Water Quality Monitoring Station (See Figure 2.0).
- 2) Pumping will be allowed when the ambient Wasteway surface water EC is no greater than the CDFG observed 2005-2009 Monthly Mean EC + the Mean Standard Error. The 30-day running average, analyzed on a weekly basis, will be used to determine whether salinity concentration has exceeded the allowable EC trigger and determine well operations in the week(s) to come.
- 3) The Upstream Real Time Water Quality Monitoring Station and Grab Sample Collection Point will be located >0.25 miles upstream of the well discharge points (See Figure 2.0). The baseline water quality data collected at the upstream sample location in combination with well head water quality data will determine if well discharge can improve salinity concentrations in the Volta Wasteway surface water.
- 4) In an effort to improve ambient Wasteway surface water quality, a Salinity Threshold Exceedance Provision (STEP Threshold) will override the surface water EC threshold. This provision will allow pumping during times when the ambient water quality produced by either production well provides salinity dilution to surface water delivered to the Volta WMA (defined as the 30-day running average EC) as measured at the Wasteway Upstream Real Time Water Quality Monitoring Station (See Figure 2.0).
- 5) An assessment of salinity inputs from outside the Volta WA will be conducted. In particular, how do facilities, subsurface drainage, surface discharges, or other activities adjacent to the Volta Wasteway and the Tri-valley Drain impact salinity. This should include an assessment of how wetland management practices impact salinity levels at the Wasteway Bridge (e.g. do seasonal wetland drawdowns in February/March drive EC levels at the Wasteway Bridge or are off-site sources the driving factors).



**Figure 1.0- EC Threshold (CDFG Observed 2005-2009 Monthly Mean EC + 5 Yr Mean Standard Error)**

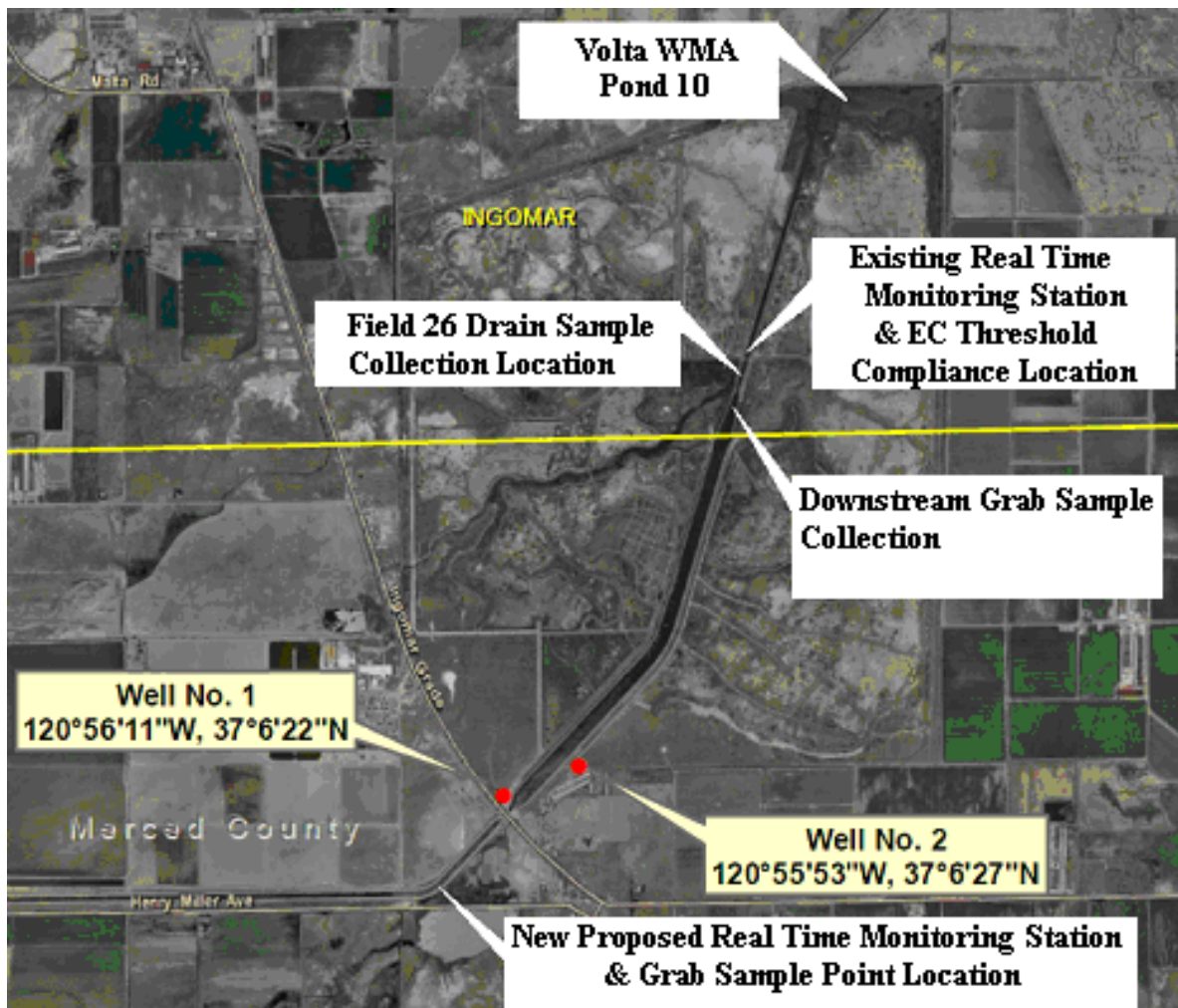


Figure 2.0 – New Proposed Upstream Monitoring Station / Sample Collection Location; Existing Downstream Real Time Monitoring Station/ Sample Collection Locations; Field 26 Drain Sample Location; Downstream Salinity Compliance Location; Year 1 Constituent Compliance at Well Heads.

## CONSTITUENT MONITORING & THRESHOLD COMPLIANCE

- 1) In an effort to comprehensively characterize the sources of and the relative ambient constituent concentrations, weekly grab sampling will occur in the first month of pumping and monthly throughout the Pilot Project Year 1 Giant Garter Snake Prey Avoidance Restricted Pumping Duration (September 1, 2010- February 28, 2011) Samples will be collected at the:
  - Upstream Monitoring Station
  - Production Well Heads
  - Downstream Grab Sample Location (upstream of the field 26 drain)
  - Field 26 Drain
- 2) Interim grab sample collection and analysis of production well head discharge constituent concentrations (Se, B, Methyl Hg, LL Hg, Total Hg) and upstream surface water constituent concentrations, will be conducted at the downstream grab sample location (upstream of the Field 26 drain- See Figure 2.0), to insure the State Water Resource Control Board water quality objectives outlined in the Central Valley Basin Plan and in the Lower San Joaquin River Total Maximum Daily Load are met. The thresholds for the following water quality constituents should be met for the pumped groundwater at the production well heads:
  - Selenium: 2.0 ug/L
  - Methyl Mercury should not exceed Volta Wasteway Methyl Mercury levels at the upstream sample point location.
  - Boron:
    1. Irrigation season (March 15 – September 15)
      - a. 0.8 mg/L (monthly mean)
      - b. 2 mg/L (maximum)
    2. Non-irrigation season (September 16-March 14)
      - a. 1 mg/L (monthly mean)
      - b. 2.6 mg/L (maximum)
- 3) At the end of the Pilot Project Year 1 Giant Garter Snake Prey Avoidance Restricted Pumping Duration (September 1, 2010- February 28, 2011), Reclamation in consultation with SLDMWA, GWD, CDFG, the research scientist who conducted the GGS monitoring, and the USFWS will evaluate the water quality monitoring and biological (GGS) data. Adjustments to the use of the

Volta wells; refinement of water quality monitoring, and implementation of measures to further protect and enhance GGS and associated habitat will be incorporated.

- 4). General Minerals (anions and cations, Nitrate, TDS, EC, and Trace Elements (Se, B, As, U, LL Hg, M Hg, Total Hg) will be collected as previously agreed. Interim surface and production well water quality samples will be analyzed for general minerals, nutrients and TDS, unless the baseline sampling event indicates that metals or organics are of potential concern.

## **THRESHOLD QUALIFICATIONS**

Reclamation recognizes that salinity and other constituent levels in water are both spatially and temporally dynamic, thus, Reclamation believes an adaptive approach that provides flexibility in water operations while addressing salinity and other water constituent conditions in the Volta Wasteway is beneficial. Such an approach requires the collection of important ground and surface water quality data. The monitoring plan and water quality-based thresholds are specific to the Volta Project and are not intended to establish set water quality thresholds for other water conveyance systems. Reclamation worked with the project proponents and the Service to develop the monitoring plan and thresholds specifically in response to the proximity of the project to one of the few breeding GGS populations within the San Joaquin Valley and water conditions within the Volta Wasteway. These thresholds are based on constituent levels within the Volta Project conveyance channels and at the well heads, and take into consideration dynamic conditions associated with many factors such as, but not limited to, flow, seepage, runoff, water management operations, and water table influence. Other projects should be evaluated independently and water quality thresholds for those projects should be based on project objectives, habitat conditions, species of concern, management goals, and water quality conditions in the associated conveyance system.

## **Biological Monitoring**

Reclamation's Biological Assessment (March 2010) describes the following practices that will be implemented to minimize environmental impacts to GGS:

- Disturbance of vegetation shall be kept to a minimum.
- No debris, soil, etc., other than that already present within the well shall be allowed to enter the water.
- No equipment shall be operated in stream channels.
- No intentional harassment, killing, or collection of plants or animals at or around the work sites is allowed.
- No firearms are allowed on site, except for those used by peace officers or CDFG wardens.
- No pets allowed.



- All persons must stay within the boundaries of the work sites, which consist of the top of the levees, walkways, public and private roadways and waters, and water-side levee slopes.
- No off-road travel or work is permitted; all vehicles must be confined to existing levee roads.
- All trash, including food-related trash and cigarette butts, must be properly disposed of and removed.
- Storage of hazardous material, such as fuel, oil, etc. shall not be allowed within 150 feet of waterways. Any chemical spills must be cleaned up immediately and reported to the Service as soon as possible.

Reclamation's Biological Assessment adopts the following Service guidelines which shall be implemented:

- Confine movement of heavy equipment to existing roadways to minimize habitat disturbance.
- Construction activity within habitat shall be conducted between May 1 and October 1. This is the active period for the snake and direct mortality is assumed to be lessened, because snakes sometimes move to avoid danger.
- Confine clearing to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project area as Environmentally Sensitive Areas. This area should be avoided by all construction personnel.
- Construction personnel shall receive FWS-approved worker environmental awareness training. This training instructs workers to recognize the snake and its habitat(s).
- The project area shall be surveyed for GGS 24 hours before construction activities. Survey of the project area should be repeated if a lapse in construction activity for two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Report any sightings and any "take" to the FWS immediately by telephone at (916) 414-6600.

Pilot borings are to precede the production well boring. Associated with these borings will be a mud pit, dug with a backhoe. The Service believes these actions may result in take of GGS. Therefore Reclamation shall provide barriers impenetrable by GGS from neonate to adult body size such as silt fencing that would prohibit entry or perhaps accidental entrapment of the giant garter snake in the mud pit. It is not clear as to the final disposal of drill cuttings other than that a location will be determined in consultation with Reclamation and CDFG which implies a location on Volta WA.

Cuttings shall not be placed in an area that may impact GGS individuals, their aquatic or upland habitat (i.e., within 200 feet of aquatic habitat).

After completion of construction activities, Reclamation shall remove any temporary fill and construction debris, and wherever feasible, restore, disturbed areas to pre-project conditions. Restoration work may include replanting species removed from banks or with emergent vegetation in the active channel. Concrete pads and locking steel monuments would be installed around the monitoring wells.

The initial water may contain high loads of sediment and constituents of Boron, Arsenic, Selenium, Mercury and more. The production wells would be sampled for the presence of selected constituents (e.g., boron, arsenic, selenium, total mercury, and methylmercury) following well development and prior to performing the aquifer tests. Results of the analyses shall be available for review by the Service prior to performing the aquifer tests. The water quality results may factor into the management decision for the large volume of water to be discharged during the aquifer tests.

## **BIOLOGICAL EVALUATION PLAN**

Reclamation proposes that a USFWS-approved giant garter snake (GGS) research scientist (with required USFWS Section 10(a)(1)(A) and CDFG scientific collecting permit(s) conduct biological monitoring at the Volta WMA in conjunction with the Pilot Project. The monitoring and evaluation is necessary to determine what effect, if any, the Pilot Project will have on existing GGS populations. The current GGS population at Volta is one of the few extant populations in the San Joaquin Valley and therefore conservation of this population is paramount to the range-wide recovery of this species. The small number of snakes in this population requires sophisticated techniques for detecting changes in population abundance. Additionally, precise mark/recapture estimates are precluded by low recapture probabilities typical of GGS. Recent statistical developments by USGS scientists allow estimation of population size when mark/recapture estimates are not practical (Halstead et al. in press 2010). These developments are very recent and require a Bayesian statistical approach. Any such statistical analysis shall be undertaken by the research scientist. To explore mechanisms leading to population or habitat change, data shall be collected on the following:

1. GGS habitat condition assessment
2. Population survey via floating minnow trap capture and release (use of PIT tags/microbranding)
3. Prey type and relative abundance
4. GGS distribution
5. Water temperature monitoring including new well water
6. Occupied habitat assessment

7. GGS health assessment (body condition observations)
8. Food chain assessment and condition
9. Reporting and recommendations for management actions

USFWS and the research scientist will confer on a data collection design that examines contaminants in animal body tissue. The research scientist will implement or will oversee implementation of that data collection over the three year biological evaluation period.

An effective evaluation must include establishing baseline data (i.e., species presence and abundance, size/age and gender distribution, etc.) prior to project implementation for comparison with post-project conditions. In order to evaluate the response of GGS to groundwater pumping at Volta WMA, the study will be conducted annually for a three-year period (the life of the pilot project). The following sections further describe how the evaluation plan will be implemented:

#### 1. GGS Habitat Condition Assessment

The habitat condition assessment may evaluate all or some of the following baseline conditions: aquatic vegetation, cover, water temperature, water velocity, thermo-regulatory habitat, and relative access to upland habitat. Habitat variables will be quantified at GGS sampling locations.

#### 2. Population Survey

A population survey of GGS shall commence as soon as possible and no later than June 2010. The survey shall extend throughout the three-year pilot project. Initial data will be collected prior to construction of the groundwater wells and shall continue following construction and operation of the wells. The survey will use modified floating minnow traps and other methods if determined to be warranted by the research scientist. Captured snakes will be marked (PIT tags/microbrand) and immediately released. This data will be analyzed to estimate the size of the Volta population of GGS over the three year period.

#### 3. Prey Type and Relative Abundance

Prey type (fish, frogs, tadpoles) will be sampled in the same modified floating traps set for GGS annually and their relative abundance determined. Baseline sampling will occur prior to construction annually during the three-year pilot period. Representative samples of prey items will be sent to a lab and analyzed for levels of contaminants of concern to USFWS (e.g., selenium, mercury *see* Wylie *et al.* 2009).

#### 4. GGS Distribution

Sampling shall determine the dynamic spatial distribution of GGS in all areas receiving the Pilot Project pumped water within Volta WMA.

#### 5. Water temperature monitoring

Temperature evaluation will occur prior to initial well development and during groundwater pumping throughout the three-year pilot period.

#### 6. Occupied Habitat Assessment

The final report shall detail areas where GGS were located and where they were not and provide restoration recommendations as to how to improve habitats and suitability for GGS.

#### 7. GGS Health Assessment

During population surveys, GGS body condition will be compared to known values reported in the literature. These measurements will be obtained over the entire three year period to assess any apparent changes over time. In addition, snakes will be visually inspected for lesions or parasitic cysts and analyzed for temporal changes.

#### 8. Food Chain Assessment and Condition

A food chain assessment and condition shall include an examination of effects due to the change in water regime, including but not limited to water velocities. Results from part #3 above will be used to compare the prey base at Volta to other sites with existing GGS populations.

#### 9. Reporting and Recommendations for Management Actions

Preliminary reports shall be produced and provided following each of the three years of the Pilot Project. These shall be combined into a final report due no later than eight months after the end of the 3-year Pilot Project. The report shall include management recommendations to conserve and enhance the Volta GGS population. Copies shall be provided to the Service and the California Department of Fish and Game. If GGS populations are determined by the research scientist to be adversely affected due to the Pilot Project, this information shall be provided in writing within one calendar week. If the Pilot Project results in “take” at any time during the three years, this information shall be provided within 24 hours. No “take” incidental or otherwise is authorized with this document.

### **Ground Subsidence**

The Reclamation contractor will coordinate with the USGS to collect ground surface elevation data (INSAR time-series data) in the vicinity of the two production wells to assess the potential for land subsidence due to groundwater extraction. A schedule for collection of the subsidence data will be determined. Reclamation will provide USGS data to the Authority, GWD WQMP and CDFG for their evaluation.

## **6. Field Data and Sample Collection**

The various team members will strive to minimize hand-entered data and provide electronic data that can be efficiently entered into project database housed at the GWD in a timely fashion. Electronic forms will be developed and used to collect basic site information at each site visit. Data quality assurance checks will also be entered into the project database. This database will be backed up and shared with the Reclamation contractor monthly or on an as needed basis. The GWD WQMP will record hydrogeologic and well sampling information on project-specific electronic field logs, included in Appendices A and B. These data will also be entered into the project database.

### **Hydrogeology**

Monitoring wells will be outfitted with vented pressure transducers and the data reported to a data logger (logged hourly) installed adjacent to each well. Monitoring wells will also be outfitted with tethered EC probes with on board logging and down loaded on a monthly basis. The GWD WQMP will collect manual QA depth to water measurements using an electronic water level indicator on a daily basis within the first week of operation, weekly within the first month of operation, and monthly during the operation period. The GWD WQMP will also collect depth to water measurements, no less than 24 hours after the onset of operation and no less than 24 hours after the end of the operational period, to characterize ground water recovery and residual drawdown of the two production wells. Each production well will be outfitted with a totalizing flow meter, solar powered data logger and security enclosure. Flow data will be logged continuously on an hourly basis. Prior to collecting the water level measurements from each production well during the pumping season, the flow rate, total flow, and electric meter reading will be recorded in the electronic field log. The procedure for groundwater level measurement and the project field log form can be found in Appendix A. If early monitoring events indicate greater variability than expected, additional monitoring events may be added.

### **Water Quality**

The GWD WQMP will collect water samples for laboratory analysis from the two production wells and the Volta Wasteway as described above prior to the first day of pumping (baseline sampling event). Sampling procedures are briefly described below. A detailed description of the sampling procedures, monitoring well purging requirements and a project field log form are included in Appendix B.

- Production Well Sampling- Baseline production well grab sampling will be conducted in conjunction with USGS during the installation of each well. Interim, monthly water samples from the two production wells will be collected using the sample tap installed at each wellhead. To collect a sample, staff will open the tap and allow a minimum of 10 gallons of water to run through the tap. Once the sample tap has been purged, and clear

water is being produced, staff will fill the laboratory-supplied sample bottles directly from the tap. Field water quality parameters (temperature, pH, and EC) will be measured during the sample collection process. Samples will be stored in a cooler containing ice until they are delivered to the analytical laboratory. Temperature and EC will be continuously logged on an hourly basis throughout the duration of the project.

- Monitoring Well Water Quality- Tethered EC probes will continuously log data throughout the duration of the project and will be manually downloaded on a monthly basis.
- Volta Wasteway Sampling- Samples will be collected using a sample bottle connected to an extension pole. The water will then be transferred to laboratory-supplied sample bottles. Samples will be stored in a cooler containing ice until they are delivered to the analytical laboratory. Field water quality parameters will be measured during the sample collection process.

## **Biological Monitoring**

Reclamation, in conjunction with USFWS and CDFG, will be responsible for the collection, interpretation, and reporting of GGS habitat (physical and biological) information in and around the Volta Wasteway and the Volta WMA.

## **Land Subsidence**

The USGS will collect ground surface elevation data (INSAR time-series data) in the vicinity of the two production wells in accordance with the plan to be developed by Reclamation.

## **Operational Information**

Production well operation, timing and duration will be determined by GWD and CDFG based on water demand, well and surface water quality, and habitat quality. In year one, pumping will occur between September 1, 2010 and February 28, 2011 and will not exceed 2,000 AF. If the well operational goal of September 1, 2010 is achieved, as well as the target maximum capacity of 1,500 gpm, pumping could occur through January 29, 2011 but no later than February 28, 2011 in year one. In years two and three, Reclamation's goal is to pump up to 5,000 AF.

During sampling or monitoring events, the status of the production wells, monitoring wells, and operating equipment will be recorded in an electronic form and photo documented periodically. These data will also be entered into the project database. Broken, damaged, vandalized and/or otherwise inoperable equipment and appurtenances will be immediately reported to Reclamation by the person who observed the damage. Field records will also note any maintenance performed on the equipment.

The condition of the erosion control features will also be recorded and photo-documented during each sampling or monitoring event. As part of the habitat observations to be conducted, appropriate environmental conditions of the Volta Wasteway and the Volta WMA will be photo-documented.

## **7. Data Collection and Management**

The GWD WQMP will collect data as described previously throughout the project duration. Field data will be entered into a master project database and protocols developed for electronic sharing of this data. The Reclamation contractor will provide technical assistance to improve the database management system through the course of the study. Electronic data will be obtained from the analytical laboratory, the monitoring stations, the USGS INSAR database, and local weather station and this will also be entered into the master project database. Field data will include water level and field water quality measurements, well purging and sampling information, and environmental and biological observations. These data will also be entered into the master project database.

### **Electronic Data**

Throughout the duration of the project, electronic data will be downloaded from multiple sources as described above. Each data source will have a unique set of download and data quality control procedures. The specific procedures are provided below.

- Laboratory data – will be uploaded to a data validation program to ensure completeness. Once the data has been electronically validated, the data file will be uploaded to the project-master database. A summary report will be generated and validated against the PDF file provided by the laboratory. The Reclamation contractor will be provided with copies of the validated quarterly via e-mail.
- Real Time Monitoring Station data – will be downloaded by the GWD WQMP as an ASCII text file. This data will be uploaded to a data quality validation program and adjustments made to the data to match QA checks. The QA validated data will be uploaded to the master project database and a summary report will be generated. The summary report will be provided by the GWD WQMP to the Reclamation contractor.
- USGS INSAR data – the USGS will provide both raw and interpreted INSAR data to the Reclamation contractor for dissemination to the GWD and the larger project team. Data formats will be chosen so that the data is compatible with the master project database housed at the GWD.
- Weather data – will be downloaded via the internet from a local weather station. The data will be exported to both a PDF file and an ASCII text data file and uploaded to the master project-database.

## **Field Data**

Field notes and photographs (as applicable) will be entered into the master project database. Depth-to-water and field water quality measurements will also be entered into the database. A summary report will be generated and validated against the hard copy field data sheets. Digital images of site photographs collected throughout the project duration will be stored in the electronic database and linked to a GIS map of the project area. Backups of the master project database will be performed weekly. These data will be provided to the Reclamation contractor quarterly.

## **8. Reporting**

The schedule for implementing the Project Monitoring Plan is based on the assumption that the two production wells and five monitoring wells will be constructed and operational by August 2010, with the first month of operation September 2010. The GWD WQMP, with the assistance of the Reclamation contractor, will submit annual reports to Reclamation, USFWS and CDFG in March 2011 and March 2012 following the completion of pumping in January of each year. The final project evaluation report, which will transmit all project data and provide an evaluation of the three-year demonstration project, will be submitted to Reclamation, USFWS and CDFG in April 2013, following completion of the monitoring program.

Data transmittal reports will include a brief description of the activities conducted during the previous pumping season, and a summary of the data collected. The data transmittal reports will also identify work that deviated from the planned activities, and provide an explanation for the deviation. A summary of the activities to be conducted during the subsequent year will also be provided.

The final report to be delivered to Reclamation, USFWS and CDFG will summarize the data collected throughout the duration of the demonstration project and provide evaluations of the various physical and environmental parameters monitored. Hydrogeologic data will be used to evaluate the specific capacity and long-term yield of the two production wells; estimate radius of influence and pumping interferences of the two production wells; and provide an assessment of the interconnection between surface water and the upper and lower aquifers, if any. Any measureable land subsidence, due to the pumping of groundwater from the lower aquifer, will also be reported.

Water quality data, including EC, temperature and dissolved metals concentrations, will be summarized and evaluated relative to any noticeable changes in the habitat documented by Reclamation over the duration of the demonstration project.



## **9. Program Schedule**

The three-year monitoring program will begin in September 2010 and will be completed by January 2013. The schedule for field sampling and data collection events is described above and summarized in Table 1. The Reclamation contractor will submit annual reports in March 2011 and March 2012, and the final report in April 2013.

Prior to the installation and development of the production wells, Reclamation will provide contractors, USFWS, CDFG and other government agencies involved in the monitoring program a copy of the monitoring plan and initial monitoring program schedule. Reclamation will keep these parties apprised of any changes to the sampling schedule or project scope.

# APPENDIX A

## Procedure for Groundwater Level Measurement

### Purpose/Application

The objective of these guidelines is to provide general reference information and technical guidance on the measurement of the depth to groundwater in an open borehole, cased borehole, monitoring well, or piezometer.

### Method Summary

When measuring groundwater levels, there should be a clearly established reference point of known elevation, which is normally the top of the well casing. The reference point should be scored or permanently marked on the rim of the casing if the casing rim is not even and level. To be useful, the reference point should be tied to a USGS benchmark or a local datum. The field notes recorded should clearly describe the reference used. An arbitrary datum could be used for an isolated group of wells if necessary.

Before measurements are made within the production well casing - water levels should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low-yield conditions, recovery of water levels to equilibrium may take longer. Groundwater levels should be measured and recorded to the nearest 0.1 foot. Water level measuring equipment must be decontaminated prior to and between each use. Water level readings from adjacent monitoring wells do not require that the production well be turned off. Pressure transducers placed within monitoring wells should be withdrawn periodically for cleaning and maintenance (especially when deployed in highly saline aquifers).

The condition of the wells, piezometers, or boreholes should be recorded along with the name of the individual who has measured the groundwater levels. The frequency of such measurements should be pre-established.

### Limitations

These guidelines give overall technical guidance only and should be modified as necessary based upon specified requirements of project-specific plans, site conditions, or equipment limitations. Agency protocols, such as those established by the USGS, can also be substituted for these guidelines given the anticipated collaboration with the USGS on this project.

### Definitions

- Water table- The surface in an unconfined aquifer where groundwater pressure is equal to atmospheric pressure.
- Potentiometric (or piezometric) surface. An imaginary surface representing the total head of groundwater in an aquifer that is defined as the level to which water would rise in a well screened at and/or beneath the water bearing zone. The water table is a particular potentiometric surface.

## Equipment

- Electronic Water Level Indicator with an accuracy of 0.1 foot or a pressure transducer selected for optimal sensitivity within the appropriate hydrostatic head range (this is typically in the range of 0 -50 ft for most monitoring well applications).
- Field notebook or data logger compatible with pressure transducer selected (battery powered transducers typically use a SDI-12 or 4-20 mA sensor interface).
- Decontamination materials (deionized water and bleach or equivalent).

An electronic water level indicator consists of a spool of graduated, small-diameter cable and a probe attached to the end. When the probe comes into contact with water, the circuit is closed and a meter, light, and/or buzzer attached to the spool will signal the contact. Nine-volt batteries are typically used for a power source. Pressure transducers contain miniature strain-gauge sensors that measure changes in electrical resistance and convert these measurements into digital signals within the solid state circuitry of the instrument. These transducers can be deployed autonomously, whereby the data is downloaded from the instrument periodically through a portable interface or continuously in cases where the instrument reports to a data logger and data is downloaded directly or via telemetry from the data logger.

## Procedures

The quality assurance procedures for measuring groundwater levels are as follows:

1. Check operation of equipment.
2. Clean all equipment entering the well by washing with an Alconox solution followed by a deionized water rinse.
3. Remove well cap, note well ID, time of day and date in site logbook or an appropriate groundwater level data form.
4. Ensure well is at equilibrium with atmospheric pressure. In wells with air tight plugs, or without vents, the hydraulic head may not be the same as in an open or vented well. Allow sufficient time for the well to equilibrate to atmospheric pressure. Several measurements may be needed to verify if equilibrium has been reached. This is especially important for wells screened in confined aquifers.
5. The probe should be lowered slowly into the well and once the buzzer sounds, slowly raised and lowered until the depth where the meter first creates a sound is determined. At this point, the depth to water is read directly from the graduated cable at the reference point, and recorded to the nearest 0.1 feet.

6. Pressure transducers that are either deployed autonomously or hard-wired to a data logger will collect hourly hydrostatic head measurements. Data will be downloaded at regular intervals. A barometric probe will be required if the pressure transducer probes are non-vented.

## **Potential Problems/Troubleshooting**

When there is high or low specific conductance, groundwater cascading in the well, or a turbulent water surface in the well, measuring groundwater levels with an electronic sounder may be difficult. Before lowering the probe into the well, the circuitry can be checked by dipping the probe in water and observing the indicator. These issues are not of concern with pressure transducer sensors. However continuous sensors can drift over time and need to be checked against well soundings at least quarterly to ensure data quality. In highly saline environments even stainless steel jacketed sensors can corrode over time. Titanium instrument casings should be chosen where possible in these situations if not cost-prohibitive.

## **References**

Fetter, C.W., 1994, Applied Hydrogeology, Third Edition, Prentice Hall Inc., pp. 691.

United States Environmental Protection Agency (USEPA) 2000, USEPA Environmental Response Team Standard Operating Procedures, Manual Water Level Measurements.

Appendix A-2

Record Form for Groundwater Level Measurement

Groundwater Level Record Form

PROJECT NAME:

PROJECT LOCATION:

PROJECT NUMBER:

DATE:

SAMPLER(S):

Well ID

Date

Depth to Water

Well Condition

Production Well 1			
Production Well 2			
MW-1			
MW-2			
MW-3			
MW-4			
MW-5			

PHOTO TAKEN

YES

NO

Photo Number:

COMMENTS:

## **APPENDIX B**

### **Procedure for Groundwater Sampling**

#### **Purpose/Application**

This groundwater purging and sampling procedure presents a standard method for collecting groundwater samples from production and monitoring wells that are representative of the formation from which they are being withdrawn. USGS standard protocols will be substituted where groundwater sampling is conducted in collaboration with USGS field personnel who have customized equipment and associated field techniques for collecting water quality samples.

#### **Equipment**

Production well sampling requires the following equipment:

- Flow measurement device (instantaneous and totalizing flow meter)
- Water level probe or pressure transducer
- 5-gallon bucket
- Multi-parameter water quality monitoring system

#### **Pre-Sampling Procedures**

The pre-sampling procedures for groundwater purging and sampling are as follows:

1. Position a 5-gallon bucket beneath the well's sampling port.
2. Measure and record the depth to water in the production well.

#### **Sampling Procedures**

Sampling procedures for groundwater purging and sampling are as follows:

1. Purging- Begin purging the well by opening the sampling port and allowing water to fill the 5-gallon bucket. Purge a minimum of 10 gallons of water from the well.

2. Field Parameter Monitoring- After purging 10 gallons, measure the temperature, pH, conductivity in the purge water. Continue purging, collecting one set of measurements for each 5 gallons purged. Record measurements on the field purge log. The well is ready to be sampled once a minimum of 20 gallons of water has been purged from the well and the field parameters are stable over three consecutive readings. The following criteria identify stabilized field parameters:
  - ± 0.1 for pH
  - ± 3.0 percent for EC
3. Sample Collection- Fill all sample containers directly from the sample port. Allow water to flow from the port, tap gently down the inside of the containers to minimize turbulence during collection. Collect groundwater samples in order of importance, according to the project requirements.